

# Cambridge International AS & A Level

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**PHYSICS**

**9702/31**

Paper 3 Advanced Practical Skills 1

**October/November 2025**

MARK SCHEME

Maximum Mark: 40

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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This document consists of **11** printed pages.









**Annotations guidance for centres**

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

**Annotations**

<b>Annotation</b>	<b>Meaning</b>
	arithmetic error
AWK	awkward scale used on graph
	benefit of the doubt given
	contradiction in response, mark not awarded
	correct point or mark awarded
	error carried forward applied
FO	false origin used on graph
	incorrect point or mark not awarded
	information missing or insufficient for credit
	power of ten error

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<b>Annotation</b>	<b>Meaning</b>
RO	read-off from graph
SH	supervisor's help given
SR	supervisor's report taken into account
SV	supervisor's value/sample results taken into account
<b>TE</b>	transcription error
<b>IR</b>	value in range
OOOR	value out of range

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Question	Answer	Marks
1(a)(i)	Value of $m = 270$ g with unit.	1
1(a)(ii)	Final value of $T_1$ in the range 0.5 s to 1.5 s with unit.	1
	Repeats: at least two measurements of $nT$ where $n \geq 5$ .	1
1(b)	$T_2 < T_1$	1
1(c)	Five sets of readings of $m$ (different values), $T_1$ and $T_2$ with correct trend (as $m$ increases $\uparrow T_1$ (average) increases $\uparrow$ and $T_2$ (average) increases $\uparrow$ ) <u>and</u> without help from Supervisor scores 4 marks, four sets scores 3 marks etc.	4
	Range of $m$ : $m_{\min} \leq 220$ g and $m_{\max} \geq 350$ g.	1
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention, e.g. $m/g$ , $nT_1/s$ , $T_1/s$ , $\sqrt{T_1} / \sqrt{s}$ , $T_1^{0.5} / s^{0.5}$ .	1
	Consistency: <u>All</u> raw values of time must be given to 0.1 s or <u>all</u> given to 0.01 s.	1
	Calculation: Correct calculation of $\sqrt{T_1}$ .	1
1(d)(i)	<p>Axes: Axes must be labelled <b>with the correct quantities</b>.</p> <p>Scales must be chosen so that the plotted points occupy at least half the graph grid in both the <math>x</math> and <math>y</math> directions.</p> <p>Scale markings are no more than 2 cm (one large square) apart.</p> <p>Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions).</p>	1

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Question	Answer	Marks
1(d)(i)	<p>Plotting of points: All observations <b>in the table</b> must be plotted on the grid.</p> <p>Diameter of plotted points must be <math>\leq</math> half a small square.</p> <p>Points must be plotted to an accuracy of half a small square in both x and y directions.</p>	<b>1</b>
	<p>Quality: Trend of points must be positive.</p> <p>All points in the table must be plotted on the grid for this mark to be awarded.</p> <p>It must be possible to draw a straight line that is within <math>0.01 \text{ s}^{1/2}</math> (to scale) on the <math>\sqrt{T_1}</math> axis (normally x-axis) of <u>all</u> plotted points.</p>	<b>1</b>
1(d)(ii)	<p>Line of best fit:</p> <p>'Best fit' is judged by the balance of all points on the grid (at least 4 points) about the candidate's line.</p> <p>There must be an even distribution of points either side of the line along the full length.</p> <p>Lines must not be kinked or thicker than half a square.</p> <p>Some candidates may choose to identify an anomalous point. If they identify <b>one</b> point as anomalous (e.g. by circling or labelling) then this point is to be disregarded when judging the line of best fit. There must be at least four points left after the anomalous point is disregarded.</p>	<b>1</b>

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Question	Answer	Marks
1(d)(iii)	<p>Gradient: gradient sign on answer line consistent with graph drawn.</p> <p>The hypotenuse of the triangle used should be greater than half the length of the drawn line.</p> <p>Both read-offs must be accurate to half a small square in both the <math>x</math> and <math>y</math> directions.</p> <p>Method of calculation must be correct, not <math>\Delta x / \Delta y</math>.</p>	<b>1</b>
	<p><math>y</math>-intercept: <b>Either</b> Intercept read directly from the graph, with read-off at <math>x = 0</math>, accurate to half a small square in <math>y</math> direction.</p> <p><b>Or</b> Correct read-off from a point on the line is substituted into <math>y = mx + c</math> or an equivalent expression.</p> <p>Read-off accurate to half a small square in both <math>x</math> and <math>y</math> directions.</p>	<b>1</b>
1(e)	<p><math>P</math> = candidate's gradient value <u>and</u> <math>Q</math> = candidate's intercept value. Values must not be written as fractions or given to one significant figure.</p>	<b>1</b>
	<p>No units for <math>P</math>. Unit for <math>Q</math> <math>\sqrt{s}</math> or <math>s^{0.5}</math>.</p>	<b>1</b>

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Question	Answer	Marks
2(a)	Values of raw $d$ to the nearest mm <u>and</u> final $d$ in range 6.5 cm to 7.5 cm.	1
	Repeats: Evidence of repeat readings of $d$ .	1
2(b)(i)	Values of raw $y$ to the nearest mm <u>and</u> final value of $y$ in the range 15.0 cm to 30.0 cm.	1
2(b)(ii)	Absolute uncertainty in $y$ in range 2 mm to 6 mm.  Correct method of calculation to find percentage uncertainty e.g. absolute uncertainty/value from <b>(b)(i)</b> $\times 100$ .  If repeated readings have been taken, then the uncertainty can be half the range if the working is clearly shown, but NOT zero if values are equal.	1
2(c)(i)	<i>Value of <math>p &lt; y</math></i>	1
2(c)(ii)	Correct calculation of $(y - p)$ .	1
2(d)	Second values of $w$ and $d$ .	1
	Second values of $y$ and $p$ .	1
	Quality : Second value of $p <$ First value of $p$ .	1
2(e)(i)	Two values of $k$ calculated correctly.	1
	The final $k$ values must not be written as fractions or given to one significant figure.	
2(e)(ii)	Justification for significant figures in $k$ linked to significant figures in $w$ and $(y - p)$ .	1
2(f)	Calculation of percentage difference between candidate's two $k$ values.	1
	Comparison of percentage difference with 10% leading to a consistent conclusion.	

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Question	Answer	Marks
2(g)(i)	<p><b>1 mark for each point up to a maximum of 4.</b></p> <p>A Two readings are <u>not enough to draw a conclusion</u> wtte, e.g. reference to relationship</p> <p>B Difficulty with setting or measuring <math>d</math>, e.g. shape is not a circle or a perfect cylinder / diameter varies around the cylinder / paper clips flatten one side / damage paper with ruler or clips</p> <p>C Difficult to measure <math>y</math> or <math>p</math> with a reason, e.g. parallax error / springs moves when touched by rule / rule not steady / deciding position of end of the coiled section</p> <p>D Difficulty with squashing the cylinder, e.g. squashes in the middle and not at the edge / uneven deformation / difficult to locate mass on middle of cylinder</p> <p>E Difficult to set or measure <math>h</math> with a reason, e.g. metre rule is unwieldy / 30 cm ruler has snout / parallax error / to move boss and observe mass (at the same time) / boss does not move (mass smoothly) in small increments / when boss is tightened (mass rises) / mass base not parallel to bench.</p>	<b>4</b>
2(g)(ii)	<p><b>1 mark for each point up to a maximum of 4.</b></p> <p>A Take more readings <u>and</u> plot a graph OR take more readings <u>and</u> compare <math>k</math> values.</p> <p>B Improved method to improve setting or measuring <math>d</math>, e.g. wrap around a proforma / use glue / tape (for cylinder) / mark a line where the two ends should meet (at <math>7\pi</math>) / place two blocks either side of the cylinder and measure between the blocks or photograph from above with a mm grid in view.</p> <p>C Improved method to measure <math>y</math> or <math>p</math>, e.g. rule with pointers / clamp ruler</p> <p>D Improved method to ensure whole of longer cylinder is squashed, e.g. Glue a plastic oblong to the mass hanger (to cover the whole cylinder).</p> <p>E Improved method to set or measure <math>h</math>, e.g. Video <u>with</u> rule in view during adjustment / depth gauge / vernier caliper / compare to a block of height 2.5 cm / rule with pointers / hang springs from jaw of a clamp to allow small adjustment in height of masses.</p>	<b>4</b>